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Inhibition of carob moth damage using *Ferula assafoetida* essential oil in pomegranate orchards of Iran

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Abstract. The carob moth, *Ectomyelois ceratoniae* is a polyphagus insect pest worldwide. In Iran it is the key pest of pomegranate and alternates to conventional insecticides are being developed. The essential oil of *Ferula assafoetida* was tested in four pomegranate orchards. In each garden 10 trees were treated with three concentrations of oil. The number of rotten fruits/tree that fell to the ground were counted and removed every 2 weeks during the season. Furthermore, the percentage of rotten fruits/ tree at the harvest time was calculated. All three concentrations of the essential oil significantly reduced fruit infestation by carob moth ($P<0.001$). However, the 1:1 dose of the oil caused fruits to be scorched. The reduction in infestation may be due to: (i) a direct repellent effect of the oil on the adult carob moth, or (ii) a disruption of mating by volatile compounds emitted by the essential oil.

Keywords. Repellency – Reproductive behavior – *Ectomyelois ceratoniae* – Medicinal plants – Clevenger.

I – Introduction

The indiscriminate use of conventional insecticides has given rise to many well-known problems, as human and domesticated animals health, and contamination of environment. These undesired effects have stimulated the search for biologically based alternatives. So, natural compounds from plants are attractive alternatives because botanicals reputedly pose little threat to the environment or to human health (Isman, 2006). Extracts or essential oils of medicinal plants have a broad spectrum of bioactivity (Baskar *et al.*, 2009; Cosimi *et al.*, 2009; Tunç and Şahinkaya, 1998) due to the presence of different ingredients which work through several mode of action.

Ferula assafoetida is a medicinal plant origin of Iran and the neighbor countries. Its essential oil is a candidate (Peyrovi *et al.*, 2011) for integrated management of the carob moth, *Ectomyelois ceratoniae* (Lep.: Pyralidae) the key pest in pomegranate orchards of Iran. In this work different concentrations of the oil were used in natural conditions of the pomegranate orchards to see if it reduces carob moth damage during the growing season 2008-2009 in Yazd province, Iran.

II – Materials and methods

1. Experimental sites

The experimental sites were located in four cities (Taft, Yazd, Meybod, Ardakan) at Yazd province, Iran. The experiment was done in one pomegranate orchard on an area of about 1 ha/site.

2. Essential oil

Ferula assafoetida gum was obtained from its herbaceous plants in Taft Mountains, Yazd, Iran. The essential oil was derived by Clevenger apparatus using hydro distillation method.

3. Field experiments

The experiments were done from June to October 2008. The oil was diluted by ethanol as solvent. Three concentrations: 1:1 (oil: solvent), 1:3, and 1:5 were prepared and sprayed on the canopy of the plants (5 ml/plant) every two weeks. Considering our laboratory studies that the solvent, ethanol in our conditions due to high volatility has not effect on repellency of the pest so, four treatments were applied (3 oil concentrations, and control without oil). In each garden 10 trees were treated with each concentration. The number of rotten fruits/tree that fell to the ground were counted and removed every 2 weeks during the growing season. Furthermore, the percentage of rotten fruits/tree at the harvested time (about early October) was calculated.

III – Results and discussion

All three concentrations of the essential oil of *F. assafoetida* significantly ($P<0.001$) reduced fruit infestation by carob moth, *Ectomyelois ceratoniae*. There was no significant differences between the experimental sites ($P>0.05$). However the highest dose, 1:1, of the oil caused the fruits to be scorched. The monoterpenes comprise the major components of essential oils and phytotoxicity of them was shown on some plants such as maize (Lee *et al.*, 1997).

The rotten fruits in treated plots that fell to the ground during the growing season were significantly lower ($P<0.001$) than the control. The percentage of infected fruits by the pest larvae in treated gardens were also significantly lower ($P<0.001$) than the control in the end of season.

The reduction in pomegranate fruits infestation may be due to the direct repellent effect of the oil on the adult carob moth, or a disruption of reproductive behavior of the adult carob moth by volatile compounds emitted by the essential oil, or combination of the two effects. Reproductive behavior of the adult insects mediated by some host plant volatile and the sex pheromone. So, calling and searching behavior belong the biological characteristics of the insects may be disrupting by air pollution and/or the non-host plant volatile compounds such as some medicinal plants (Bisseleua *et al.*, 2008; Kumar *et al.*, 2008)

Our study revealed some essential oils can be used in integrated pest management programs as the safe compounds for human health but the effect of the oils on insect natural enemies must be well studied. It has been shown that there are some negative effects on biological and behavioral characteristics of some insect natural enemies, *Telenomus busseolae* (Hym. Scelionidae) and *Trichogramma* spp. (Hym.: Trichogrammatidae) (Bayram *et al.*, 2010; Poorjavad *et al.*, 2011). So, we suggest the essential oils may be used with the insect natural enemies in IPM programs, not simultaneously but periodically. Complementary studies under laboratory and field conditions are needed to determine how may be used the live biological agents and the botanical insecticides such as essential oils in combination in IPM programs.

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